Synthetic Metals

Low field microwave absorption in iron nanoparticles embedded polyaniline nanofibers composite

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Abstract
Low field microwave absorption (LFMA) in conducting polymers is completely different as compared to magnetic systems and is very intriguing. To understand LFMA phenomenon in the conducting polymers, we studied LFMA in the conducting polyaniline (PANI) polymer and iron nanoparticles (NPs) embedded polyaniline nanofibers (PANI-Fe) composite systems. PANI-Fe composite nanofibers were prepared by rapid mixing chemical polymerization of ANI monomer using FeCl3 as an oxidant and followed by the reduction of Fe2+/Fe3+ ions for the deposition of Fe NPs onto the PANI nanofibers matrix. Formation of PANI and deposition of Fe NPs were confirmed by HR-TEM, XRD and ATR-FTIR analyses, respectively. The study showed that in spite of PANI being non-degenerate conducting polymer, LFMA is absent in pure PANI. In contrary, LFMA signals are observed in Fe NPs embedded PANI nanofibers and bare Fe NPs systems. Presence of minor hysteresis in LFMA, as compared to the substantial magnetization hysteresis and the fact that LFMA derivative peaks not having any correlation with the M−H loop anisotropy and coercive fields rules out the conventional interpretation of LFMA arising from the low field spin magnetization processes as reported in the literature. Further it is perceived that microwave absorption in PANI-Fe system has a maximum at zero field and decreases with increasing applied magnetic field. This is totally in contradiction with the predicted behaviour of polaron-bipolaron based mechanism of LFMA origin, where the microwave absorption has a minimum at zero field and increases with the field in the case of non-degenerate conducting polymers, as reported in literature. However, LFMA correlates well with the magnetoresistance data for the PANI-Fe composite nanofibers system, indicating LFMA in this system is actually governed by magneto transport and not exactly by the low field magnetization process itself.